PBEEEP
State Government

Public Buildings Enhanced Energy Efficiency Program

Final Report
Investigation Results For
State Office Building

Date: 2/9/2012

Admin Minnesota
DEPARTMENT OF ADMINISTRATION

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ENERGY STAR 98

This site may be eligible to apply for the ENERGY STAR.

PBEEEP
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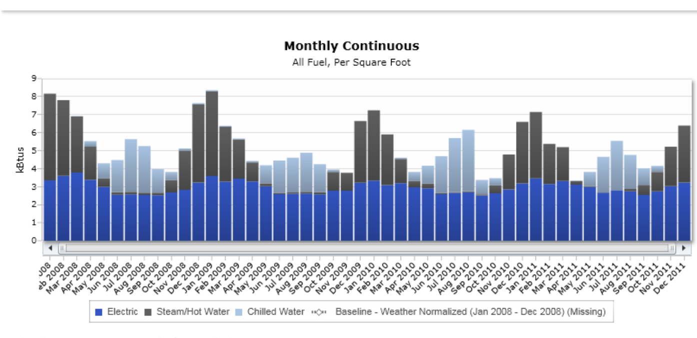
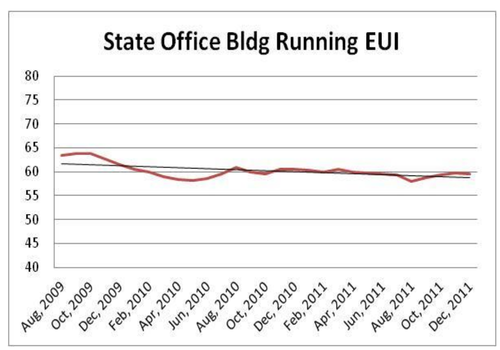
State Office Building Energy Investigation Overview

The goal of a PBEEEP Energy Investigation is to identify energy savings opportunities with a payback of fifteen years or less. Particular emphasis is on finding those opportunities that will generate savings with a relatively fast (1 to 5 years) and certain payback. During the investigation phase the provider conducts a rigorous analysis of the building operations. Through observation, targeted functional testing, and analysis of extensive trend and portable logger data, the RCx Provider identifies deficiencies in the operation of the mechanical equipment, lighting, envelope, and related controls. The investigation of State Office Building was performed by Hammel, Green and Abrahamson, Inc. This report is the result of that information.

Payback Information and Energy Savings				
Total project costs (Without Co-funding)			**Project costs with Co-funding**	
Total costs to date including study	$49,947		Total Project Cost	$220,809
Future costs including Implementation , Measurement & Verification	$170,862		Study and Administrative Cost Paid with ARRA Funds	($54,947)
Total Project Cost	$220,809		Utility Co-funding	($23,475)
			Total costs after co-funding	$142,387
Estimated Annual Total Savings ($)	$28,437		Estimated Annual Total Savings ($)	$28,437
Total Project Payback	9.8		Total Project Payback with co-funding	5.0
Electric Energy Savings (280,099 of 3,173,130 kWh (2011))	**9.2%**	**and**	**District Energy Savings (Hot Water) (349 of 4,407 MMBtu (2011))**	**7.9%**





State Office Building Consumption Report
Total energy use decreased about 1.5% during the period of the investigation

Admin Minnesota STATE OF MINNESOTA B3 BENCHMARKING

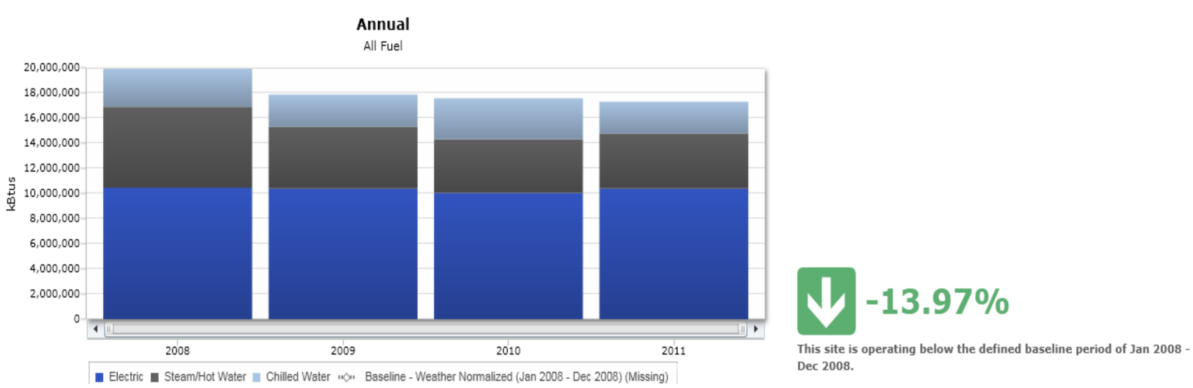
Summary Tables

State Office Building	
Location	100 Rev Dr Martin Luther King Jr Blvd, St. Paul, MN
Facility Manager	Gordon Specht
Interior Square Footage	272,085
PBEEEP Provider	Hammel, Green and Abrahamson, Inc.
State’s Project Manager	Harvey Jaeger
Annual Energy Cost	$ 357,400 (2011) Source: B3
Utility Company	Xcel Energy (Electric and Natural Gas) District Energy St Paul (Hot Water)
Site Energy Use Index (EUI)	60 kBtu/ft^2 (at end of study)
Benchmark EUI (from B3)	106 kBtu/ft^2

Building Name	State ID	Area (Square Feet)	Year Built
State Office Building	G0231010462	272,085	1931

Mechanical Equipment Summary Table (of buildings included in the investigation)	
Quantity	**Equipment Description**
1	Building Automation System (Honeywell EBI)
15	Air Handlers
468	Fan Coil Units
4	Pumps (2 HW for AHU’s, 2 HW for circulation)
150-200	Approximate number of points recommended trended, plus 5 data loggers

5 Year Energy Use Shows a 14% decrease from the B3 Baseline Year



Implementation Information			
Estimated Annual Total Savings ($)			$28,437
Total Estimated Implementation Cost ($)			$165,862
GHG Avoided in U.S Tons (CO2e)			266
Electric Energy Savings (kWh) 9.2 % Savings 2011 Electric Usage 3,039,932 kWh (from B3)			280,099
Electric Demand Savings (Peak kW) 0 % Savings NA			73
District Hot Water Savings (MMBtu) 7.9% Savings 2011 District Hot Water usage 4,407 MMBtu from B3			349
Statistics			
Number of Measures identified			6
Number of Measures with payback < 3 years			1
Screening Start Date	5/3/2010	Screening End Date	6/21/2010
Investigation Start Date	9/29/2010	Investigation End Date	11/22/2011
Final Report	2/10/2012		

State Office Building Cost Information			
Phase		**To date**	**Estimated**
Screening		$2,226	
Investigation [Provider]		$43,200	
Investigation [CEE]		$4,521	$1,000
Implementation			$165,862
Implementation [CEE]			$2,000
Measurement & Verification		0	$2,000
Total		$49,947	$170,862

Co-funding Summary	
Study and Administrative Cost	$54,947
Utility Co-Funding - Estimated Total ($)	$23,475
Total Co-funding ($)	$78,422

Facility Overview

The energy investigation identified 7.5% of total energy savings at State Office Building with measures that payback in less than 15 years and do not adversely affect occupant comfort. The energy savings opportunities identified at State Office Building are based on adjusting the schedule of equipment to match actual building occupancy hours, improving the efficiency of the building lighting, and installing VFDs on a number of pumps. The total cost of implementing all the measures is $165,862.

Implementing all these measures can save the facility approximately $28,437 a year with a combined payback period of 5.8 years before rebates based on the implementation cost only (excluding study and administrative costs). After rebates the site will have a cost of $142,387, which reduces the payback to 5.0 years. These measures will produce 9.2% electrical savings and 7.9% steam/hot water savings. The building is currently performing at 43% below the Minnesota Benchmarking and Beyond database (B3) benchmark value.

The primary energy intensive systems at State Office Building are described here:

The State Office Building is one large building consisting of 272,085 interior square feet. The building is controlled by a Honeywell EBI building automation system which is part of the State Capitol Complex system. All equipment is on the automation system except several unit heaters, which are controlled by manual thermostats on the wall. The building was constructed in 1931. The HVAC systems are mostly original except for some motor replacements and the controls which are upgraded. The occupancy varies throughout the year; it is highest during the state legislative session which runs from January through May. There is significantly lower occupancy in the summer.

The heating and cooling energy at the State Office Building is delivered by the District Energy to the state capitol loop which serves all the buildings on the capitol campus. The control of heating and cooling availability is based on outside air temperature and is controlled by the capitol loop, not the State Office Building. Heating is available when the outside air temperature is below 49°F and cooling is available above 64°F. There is no zone control for heating; if the heating pumps are running the building is heating. The heating system is split between AHUs and zone heat (FCUs and reheats) by different pumps and loops. The same is true for cooling, except there are no cooling loop pumps, just valves from the campus loop. Frequent manual adjustments by the building staff are required to maintain comfort for the occupants.

The two large VAV AHUs serve the first five floors, split into two halves (North and West; South and East). The ten smaller constant volume AHUs serve conference rooms, one AHU per room, all have cooling but only a few have heat. The sixth and seventh floors each have an AHU with both heating and cooling. The State Office Building has no true utility meters; however it has one electric meter, one hot water usage meter, and one chilled water usage meter. These are all submeters of the campus energy loops.

The site Energy Use Index (EUI) for the campus is 60 $kBtu/ft^2$, which is 43% lower than the B3 Benchmark of 106 $kBtu/ft^2$.

Findings Summary

Building: State Office Building
Site: State Office Building

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
6	Building FCU Operate more than they should	$5,000	$5,599	0.89	$0	0.89	39
5	Infiltration through AHU-S14 and 15 because of EF-2 and EF-3 operation	$17,300	$4,470	3.87	$0	3.87	25
8	Implement more efficient lighting options.	$109,023	$15,030	7.25	$3,752	7.00	152
3	Parking Garage Exhaust Fans Operate 24/7	$7,000	$917	7.64	$0	7.64	13
4	FCU/AHU HW Pump VFD's not provided.	$20,840	$1,801	11.57	$3,700	9.52	26
7	Building Air Compressor operates more than it should.	$6,699	$621	10.79	$0	10.79	9
	Total for Findings with Payback 3 years or less:	**$5,000**	**$5,599**	**0.89**	**$0**	**0.89**	**39**
	Total for all Findings:	**$165,862**	**$28,437**	**5.83**	**$7,452**	**5.57**	**266**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

PBEEEP State Government

Rev. 2.0 (12/16/2010)

12100 - State Office Building

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	**a.1 (1)**	Time of Day enabling is excessive	Exhaust Fan Operation/FCU	Mech Room Penthouse		FCU's/Main building exhaust operating 24/7. AHU's scheduled as required. HW Pumps operated below 30 degrees.
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive			Investigation looked for, but did not find this issue.	Current static pressure setpoints are set at 1" and 1.1" on AHU's w/ VFD's.
	a.3 (3)	Lighting is on more hours than necessary.			Not cost-effective to investigate	Lighting is on during regular business hours and for cleaning. Internal lights on 18 Hours/day. Perimeter office lights on only when occupied during session.
	a.4 (4)	OTHER_Equipment Scheduling/Enabling			Not Relevant	Main equipment is scheduled as required.
b. Economizer/Outside Air Loads:	**b.1 (5)**	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)			Investigation looked for, but did not find this issue.	Economizer operation operates correctly on larger units. Smaller units work somewhat, issue is size of units and hours of operation make it not cost effective to look into optimizing existing economizer operation.
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.	AHU S-14	Penthouse		Finding was located on AHU with disconnected OA damper linkage. All AHU's deliver minimal OA when not economizing. Finding has already been corrected.
	b.3 (7)	OTHER_Economizer/OA Loads			Not Relevant	
c. Controls Problems:	**c.1 (8)**	Simultaneous Heating and Cooling is present and excessive			Not Relevant	Facility does not have ability to heat and cool together (district energy). Cooling enable setpoint is above heating enable setpoint.
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement			Not cost-effective to investigate	One MAT appears to pickup heat from the HW Coil. It does not seem to effect unit performance.
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints			Not Relevant	HW and CHW outdoor air temp enable is far enough away where this does not occur.
	c.4 (11)	OTHER_Controls			Not Relevant	
d. Controls (Setpoint Changes):	**d.1 (12)**	Daylighting controls or occupancy sensors need optimization.			Not Relevant	No daylighting controls at the facility. Will look into direct fixture replacement for lighting savings.
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.			Not cost-effective to investigate	High zone temperatures during winter. Believe to be the case due to FCU operation and thermostat related issues on VAV boxes. Chris at SOB is working on T-Stat issues.
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently			Investigation looked for, but did not find this issue.	Current static pressure setpoints are set at 1" and 1.1" on AHU's w/ VFD's.
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently			Not Relevant	Heating pumps do not have VFD's (Has been addressed), chilled water pumps used very little.
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary			Not Relevant	
	d.6 (17)	Other_Controls (Setpoint Changes)			Not Relevant	
e. Controls (Reset Schedules):	**e.1 (18)**	HW Supply Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	Temperature follows reset schedule.
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	Does not have the ability to reset temperature because it uses district energy supply water temperature. District energy delivers 42-43 degree water.
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	The two building AHU's S1, S2 supply 60 degrees. AHU's S14, S15 supply between 55 and 56 in summer but return temperatures are between 74 and 76. The smaller units supply between 55 and 60, internally loaded spaces (Conference rooms).
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	Current static pressure setpoints are set at 1" and 1.1" on AHU's w/ VFD's.
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal			Not Relevant	Utilizes district energy, no condenser water.
	e.6 (22)	Other_Controls (Reset Schedules)			Not Relevant	
f. Equipment Efficiency Improvements / Load Reduction:	**f.1 (23)**	Daylighting Control needs optimization—Spaces are Over-Lit			Investigation looked for, but did not find this issue.	Daylighting controls not implemented. Looking into direct fixture replacement.
	f.2 (24)	Pump Discharge Throttled			Investigation looked for, but did not find this issue.	
	f.3 (25)	Over-Pumping			Investigation looked for, but did not find this issue.	Chilled water pumps rarely operate, HW pumps are constant volume and serve two respective loops, FCU and AHU loop.
	f.4 (26)	Equipment is oversized for load.			Investigation looked for, but did not find this issue.	

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	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction			Not Relevant	
g. Variable Frequency Drives (VFD):	g.1 (28)	VFD Retrofit - Fans			Not cost-effective to investigate	Larger Fans utilize VFD's, fans without VFD's are 5 HP and smaller.
	g.2 (29)	VFD Retrofit - Pumps	No VFD's on HW pumps	Mech Room - Basement		Adding to HW Pumps, Chilled water pumps have VFD's and rarely operate.
	g.3 (30)	VFD Retrofit - Motors (process)			Not Relevant	
	g.4 (31)	OTHER_VFD			Not Relevant	
h. Retrofits:	h.1 (32)	Retrofit - Motors			Not cost-effective to investigate	Spot verified motors to see if replacement had a reasonable payback. Due to the reduced runtime of much of the equipment, payback exceeded 15 years.
	h.2 (33)	Retrofit - Chillers			Not Relevant	District Energy for cooling, remaining DX coils on AHU's being converted.
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)			Not cost-effective to investigate	All DX systems for AHU's are currently being replaced with Chilled Water coils. Coils are on sight and transition has begun.
	h.4 (35)	Retrofit - Boilers			Not Relevant	District Energy
	h.5 (36)	Retrofit - Packaged Gas fired heating			Not Relevant	
	h.6 (37)	Retrofit - Heat Pumps			Not Relevant	
	h.7 (38)	Retrofit - Equipment (custom)			Not Relevant	
	h.8 (39)	Retrofit - Pumping distribution method			Investigation looked for, but did not find this issue.	Facility utilizes district energy, hot water pumping direct return through heat exchangers. Very minimal pumping for chilled water.
	h.9 (40)	Retrofit - Energy/Heat Recovery			Not Relevant	
	h.10 (41)	Retrofit - System (custom)			Not Relevant	
	h.11 (42)	Retrofit - Efficient Lighting				Looked at direct replacement of existing lighting to more efficient option. See calculation. Garage lighting already being addressed.
	h.12 (43)	Retrofit - Building Envelope			Not Relevant	
	h.13 (44)	Retrofit - Alternative Energy			Not Relevant	
	h.14 (45)	OTHER_Retrofit			Not Relevant	
i. Maintenance Related Problems:	i.1 (46)	Differed Maintenance from Recommended/Standard	Air Compressor Failure/VAV T-Stats			Chris will be recalibrating all T-Stats on the VAV's, Looking into correcting the air compressor issues (replacement).
	i.2 (47)	Impurity/Contamination			Not Relevant	
	i.3 ( )	Leaky/Stuck Damper	AHU S-14	Penthouse		Dampers on AHU-14 and AHU-15 are faulty and will be addressed in EF finding. Damper already replaced on OA of AHU-S1. Damper has already been corrected.
	i.4 ( )	Leaky/Stuck Valve			Not Relevant	
	i.5 (48)	OTHER_Maintenance			Not Relevant	
j. OTHER	j.1 (49)	OTHER			Not Relevant	

Findings Glossary: Findings Examples

a.1 (1)	**Time of Day enabling is excessive**
	• HVAC running when building is unoccupied. Equipment schedule doesn't follow building occupancy • Optimum start-stop is not implemented • Controls in hand
a.2 (2)	**Equipment is enabled regardless of need, or such enabling is excessive**
	• Fan runs at 2" static pressure. Lowering pressure to 1.8" does not create comfort problem and the flow is per design. • Supply air temperature and pressure reset: cooling and heating
a.3 (3)	**Lighting is on more hours than necessary**
	• Lighting is on at night when the building is unoccupied • Photocells could be used to control exterior lighting • Lighting controls not calibrated/adjusted properly
a.4 (4)	**OTHER Equipment Scheduling and Enabling**
	• Please contact PBEEEP Project Engineer for approval
b.1 (5)	**Economizer Operation – Inadequate Free Cooling**
	• Economizer is locked out whenever mechanical cooling is enabled (non-integrated economizer) • Economizer linkage is broken • Economizer setpoints could be optimized • Plywood used as the outdoor air control • Damper failed in minimum or closed position
b.2 (6)	**Over-Ventilation**
	• Demand-based ventilation control has been disabled • Outside air damper failed in an open position • Minimum outside air fraction not set to design specifications or occupancy
b.3 (7)	**OTHER Economizer/Outside Air Loads**
	• Please contact PBEEEP Project Engineer for approval
c.1 (8)	**Simultaneous Heating and Cooling is present and excessive**
	• For a given zone, CHW and HW systems are unnecessarily on and running simultaneously • Different setpoints are used for two systems serving a common zone
c.2 (9)	**Sensor / Thermostat needs calibration, relocation / shielding, and/or replacement**
	• OAT temperature is reading 5 degrees high, resulting in loss of useful economizer operation • Zone sensors need to be relocated after tenant improvements • OAT sensor reads high in sunlight
c.3 (10)	**Controls "hunt" / need Loop Tuning or separation of heating/cooling setpoints**
	• CHW valve cycles open and closed • System needs loop tuning – it is cycling between heating and cooling
c.4 (11)	**OTHER Controls**
	• Please contact PBEEEP Project Engineer for approval
d.1 (12)	**Daylighting controls or occupancy sensors need optimization**
	• Existing controls are not functioning or overridden • Light sensors improperly placed or out of calibration
d.2 (13)	**Zone setpoint setup / setback are not implemented or are sub-optimal**
	• The cooling setpoint is 74 ºF 24 hours per day
d.3 (14)	**Fan Speed Doesn't Vary Sufficiently**
	• Fan runs at 2" static pressure. Lowering pressure to 1.8" does not create comfort problem and the flow is per design. • Supply air temperature and pressure reset: cooling and heating

d.4 (15)	**Pump Speed Doesn't Vary Sufficiently**	
		• Pump runs at 15 PSI on peak day. Lowering pressure to 12 does not create comfort problem and the flow is per design. Low ΔT across the chiller during low load conditions.
d.5 (16)	**VAV Box Minimum Flow Setpoint is higher than necessary**	
		• Boxes universally set at 40%, regardless of occupancy. Most boxes can have setpoints lowered and still meet minimum airflow requirements.
d.6 (17)	**Other Controls (Setpoint Changes)**	
		• Please contact PBEEEP Project Engineer for approval
e.1 (18)	**HW Supply Temperature Reset is not implemented or is sub-optimal**	
		• HW supply temperature is a constant 180 ºF. It should be reset based on demand, or decreased by a reset schedule as OAT increases. • DHW Setpoints are constant 24 hours per day
e.2 (19)	**CHW Supply Temperature Reset is not implemented or is sub-optimal**	
		• CHW supply temperature is a constant 42 ºF. It could be reset, based on demand or ambient temperature.
e.3 (20)	**Supply Air Temperature Reset is not implemented or is sub-optimal**	
		• The SAT is constant at 55 ºF. It could be reset to minimize reheat and maximize economizer cooling. The reset should ideally be based on demand (e.g., looking at zone box damper positions), but could also be reset based on OAT.
e.4 ( )	**Supply Duct Static Pressure Reset is not implemented or is suboptimal**	
		• The Duct Static Pressure (DSP) is constant at 1.5" wc. It could be reset to minimize fan energy. The reset should ideally be based on demand (e.g. looking at zone box damper positions), but could also be reset based on OAT.
e.5 (21)	**Condenser Water Temperature Reset is not implemented or is sub-optimal**	
		• CW temperature is constant leaving the tower at 85 ºF. The temperature should be reduced to minimize the total energy use of the chiller and tower. It may be worthwhile to reset based on load and ambient conditions.
e.6 (22)	**Other Controls (Reset Schedules)**	
		• Please contact PBEEEP Project Engineer for approval
f.1 (23)	**Lighting system needs optimization - Spaces are overlit**	
		• Lighting exceeds ASHRAE or IES standard levels for specific space types or tasks
f.2 (24)	**Pump Discharge Throttled**	
		• The discharge valve for the CHW pump is 30% open. The valve should be opened and the impeller size reduced to provide the proper flow without throttling.
f.3 (25)	**Over-Pumping**	
		• Only one CHW pump runs when one chiller is running. However, due to the reduced pressure drop in the common piping, the pump is providing much greater flow than needed.
f.4 (26)	**Equipment is oversized for load**	
		• The equipment cycles unnecessarily • The peak load is much less than the installed equipment capacity

f.5 (27)	**OTHER Equipment Efficiency/Load Reduction**	
		• Please contact PBEEEP Project Engineer for approval
g.1 (28)	**VFD Retrofit Fans**	
		• Fan serves variable flow system, but does not have a VFD. • VFD is in override mode, and was found to be not modulating.
g.2 (29)	**VFD Retrofit - Pumps**	
		• 3-way valves are used to maintain constant flow during low load periods. • Only one CHW pumps runs when one chiller is running. However, due to the reduced pressure drop in the common piping, the pump is providing much greater flow than needed.
g.3 (30)	**VFD Retrofit - Motors (process)**	
		• Motor is constant speed and uses a variable pitch sheave to obtain speed control.
g.4 (31)	**OTHER VFD**	
		• Please contact PBEEEP Project Engineer for approval
h.1 (32)	**Retrofit - Motors**	
		• Efficiency of installed motor is much lower than efficiency of currently available motors
h.2 (33)	**Retrofit - Chillers**	
		• Efficiency of installed chiller is much lower than efficiency of currently available chillers
h.3 (34)	**Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)**	
		• Efficiency of installed air conditioner is much lower than efficiency of currently available air conditioners
h.4 (35)	**Retrofit - Boilers**	
		• Efficiency of installed boiler is much lower than efficiency of currently available boilers
h.5 (36)	**Retrofit - Packaged Gas-fired heating**	
		• Efficiency of installed heaters is much lower than efficiency of currently available heaters
h.6 (37)	**Retrofit - Heat Pumps**	
		• Efficiency of installed heat pump is much lower than efficiency of currently available heat pumps
h.7 (38)	**Retrofit - Equipment (custom)**	
		• Efficiency of installed equipment is much lower than efficiency of currently available equipment
h.8 (39)	**Retrofit - Pumping distribution method**	
		• Current pumping distribution system is inefficient, and could be optimized. • Pump distribution loop can be converted from primary to primary-secondary)
h.9 (40)	**Retrofit - Energy / Heat Recovery**	
		• Energy is not recouped from the exhaust air. • Identification of equipment with higher effectiveness than the current equipment.
h.10 (41)	**Retrofit - System (custom)**	
		• Efficiency of installed system is much lower than efficiency of another type of system
h.11 (42)	**Retrofit - Efficient lighting**	
		• Efficiency of installed lamps, ballasts or fixtures are much lower than efficiency of currently available lamps, ballasts or fixtures.

h.12 (43)	**Retrofit - Building Envelope**	
		• Insulation is missing or insufficient • Window glazing is inadequate • Too much air leakage into / out of the building • Mechanical systems operate during unoccupied periods in extreme weather
h.13 (44)	**Retrofit - Alternative Energy**	
		• Alternative energy strategies, such as passive/active solar, wind, ground sheltered construction or other alternative, can be incorporated into the building design
h.14 (45)	**OTHER Retrofit**	
		• Please contact PBEEEP Project Engineer for approval
i.1 (46)	**Differed Maintenance from Recommended/Standard**	
		• Differed maintenance that results in sub-optimal energy performance. • Examples: Scale buildup on heat exchanger, broken linkages to control actuator missing equipment components, etc.
i.2 (47)	**Impurity/Contamination**	
		• Impurities or contamination of operating fluids that result in sub-optimal performance. Examples include lack of chemical treatment to hot/cold water systems that result in elevated levels of TDS which affect energy efficiency.
i.3 ( )	**Leaky/Stuck Damper**	
		• The outside or return air damper on an AHU is leaking or is not modulating causing the energy use go up because of additional load to the central heating and/or cooling plant.
i.4 ( )	**Leaky/Stuck Valve**	
		• The heating or cooling coil valve on an AHU is leaking or is not modulating causing the energy use go up because of additional load to the central heating and/or cooling plant.
i.5 (48)	**OTHER Maintenance**	
		• Please contact PBEEEP Project Engineer for approval
j.1 (49)	**OTHER**	
		• Please contact PBEEEP Project Engineer for approval

Findings Details

Building: State Office Building

FWB Number:	12100	Eco Number:	3
Site:	State Office Building	Date/Time Created:	2/6/2012

Investigation Finding:	Parking Garage Exhaust Fans Operate 24/7	Date Identified:	11/1/2010
Description of Finding:	The parking garage exhaust fans previously operated off CO monitoring. They currently are operating 24/7. It would be beneficial to look into going back to CO monitoring.		
Equipment or System(s):	Other	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Equipment is enabled regardless of need, or such enabling is excessive		

Implementer:	Controls Contractor and in House Staff	Benefits:	Energy Savings
Baseline Documentation Method:	Currently the exhaust fans do not have a BAS interface or schedule. Through discussions with building staff, it was discovered the exhaust fans operate 24/7. Spot measurements will help to verify the existing unit operation and help with the baseline calculation for existing energy usage.		
Measure:	CO monitors installed in the parking garage could be used to control the existing exhaust fan operation. A reduction in fan operation would result in energy savings.		
Recommendation for Implementation:	The recommendation for implementation is to re-Install CO monitors in the parking garage in the previously installed location. An additional two CO monitors will be provided on the opposite wall locations of the existing locations to ensure adequate CO monitoring is conducted. The CO monitors will be utilized to provide a start/stop sequence for the existing exhaust fans in the lower level parking garage. When the CO PPM rises above the determined high level limit, the exhaust fans will begin to operate. When the CO monitors indicate the space has returned to proper levels, the exhaust fans will be sequenced off.		
Evidence of Implementation Method:	Provide amperage data logger and trend exhaust fan operation over one week length of time. Verify units operate and turn off between heavy use and light use of ramp parking. This trending should be conducted during session and during non-session times when parking ramp use is at its peak and minimum usage. Use of CO gas would also demonstrate proper use of the CO monitor.		

Annual Electric Savings (kWh):	15,560	Contractor Cost ($):	$6,000
Estimated Annual kWh Savings ($):	$917	PBEEEP Provider Cost for Implementation Assistance ($):	$1,000
		Total Estimated Implementation Cost ($):	$7,000

Estimated Annual Total Savings ($):	$917	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	7.64	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	7.64	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	13	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	3.2%	Percent of Implementation Costs:	4.2%

Findings Details

Building: State Office Building

FWB Number:	12100	Eco Number:	4
Site:	State Office Building	Date/Time Created:	2/6/2012

Investigation Finding:	FCU/AHU HW Pump VFD's not provided.	Date Identified:	2/18/2011
Description of Finding:	The FCU/AHU HW pumps do not have VFD's to modulate flow.		
Equipment or System(s):	Other	Finding Category:	Variable Frequency Drives (VFD)
Finding Type:	VFD Retrofit - Pumps		

Implementer:	Controls Contractor/Mechanical Contractor	Benefits:	Energy Savings
Baseline Documentation Method:	The baseline operation was trended with the use of the hot water supply and return water temperature for both the AHU loop and the FCU loop. This demonstrated hot water flow in each respective loop. Discussions with Scott Miron indicated when the pumps are enabled and disabled to arrive at a proper pump runtime. Spot measurements were done to help determine baseline pump operating conditions and energy consumption.		
Measure:	Implementing VFD's on AHU and FCU pumping loops.		
Recommendation for Implementation:	This recommendation for implementation is to install VFD's on HW pumps, two VFD's for the AHU heating loop and two VFD's for the FCU heating loop. Controls Contractor to provide differential pressure sensor in each piping loop for VFD control. Controls contractor to set min/max VFD speed based off flow in piping system when all valves are open in the system and all valves are closed in the system. Mechanical contractor to alter piping on AHU coils by converting three way valves into two way valves by disconnecting bypass leg of three way coil and providing cap on respective leg on AHU's S1 through S15. Provide bypass in both FCU and AHU heating loops with two way modulating valve to set minimum flow for pump when all valves are in a closed position and bypass valve in open position.		
Evidence of Implementation Method:	Trending of VFD speed, supply and return water temperatures on both FCU and AHU loops, bypass valve position, and OAT will be trended for two week periods during both design heating conditions and non-design conditions to ensure VFD's are modulating as intended. The trending will be conducted on 15 minute intervals. In addition, trending of pump operation (VFD speed) during non heating seasons will verify pumps are not operating when heating is not required.		

Annual Electric Savings (kWh):	30,567	Contractor Cost ($):	$16,840
Estimated Annual kWh Savings ($):	$1,801	PBEEEP Provider Cost for Implementation Assistance ($):	$4,000
		Total Estimated Implementation Cost ($):	$20,840

Estimated Annual Total Savings ($):	$1,801	Utility Co-Funding for kWh ($):	$3,700
Initial Simple Payback (years):	11.57	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	9.52	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	26	Utility Co-Funding - Estimated Total ($):	$3,700

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	6.3%	Percent of Implementation Costs:	12.6%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: State Office Building

FWB Number:	12100	Eco Number:	5
Site:	State Office Building	Date/Time Created:	2/6/2012

Investigation Finding:	Infiltration through AHU-S14 and 15 because of EF-2 and EF-3 operation	Date Identified:	4/6/2011
Description of Finding:	General building exhaust fans (EF-2,3) operate 24/7. Units could operate with the building AHU schedules. Because of the negative pressure in the building at night, there is excessive infiltration through the leaky OA damper sets.		
Equipment or System(s):	Other	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Equipment is enabled regardless of need, or such enabling is excessive		

Implementer:	Controls Contractor/Mechanical Contractor	Benefits:	Energy Savings
Baseline Documentation Method:	The baseline operation was trended with the use of amperage data loggers on one of the exhaust fans. This was done for a 1 week period to determine the baseline operation was 24/7. Spot measurements of voltage and amperage was conducted on both fans to determine existing energy consumption. The MAT and DAT were als otrended for two weeks to see how quickly the units went into freeze protection.		
Measure:	Adjust EF schedule/interlock EF with AHU operation and install new OA dampers on the two units to reduce infiltration and exfiltration.		
Recommendation for Implementation:	This recommendation includes two portions of implementation: First, the controls contractor to interlock EF-2 and EF-3 with AHU schedule to ensure exhaust fans operate with AHU schedules. Using one of the four main AHU's (S1 ,S2, S14, or S15) will ensure the exhaust fans will operate when the building is to be occupied. Second, the mechanical contractor is to replace OA dampers on AHU S-14 and S-15. The contractor is to remove the louver on the outside of AHU's and remove/replace OA dampers. The contractor is to verify existing damper sizing. The damper will be replaced with an opposed blade, low leakage damper. Upon reinstallation, ensure proper damper closure with existing pneumatic actuator. Reinstall the louver upon damper replacement.		
Evidence of Implementation Method:	Trending of amperage for exhaust fans with the use of a data logger for a one week period to determine the exhaust fans are operating with the AHU schedule. Trending of AHU fan status/VFD speed for same period will give comparison of exhaust fan status to AHU schedule. Also, physical verification of the new OA damper during occupied and unoccupied times will demonstrate a positive closure of the OA damper when system is off and the damper is modulating when the system is on. Trending of the damper position, RAT, MAT, and OAT will demonstrate damper modulation when system is operating and economizer control. The %OA should also be calculated withthe dampers shut to show low leakage.		

Annual Electric Savings (kWh): Estimated Annual kWh Savings ($):	15,245 $898	Annual District Energy-Hot Water Savings (Gallons): Est Annual District Energy-Hot Water Savings ($):	169,413 $3,572
Contractor Cost ($): PBEEEP Provider Cost for Implementation Assistance ($): Total Estimated Implementation Cost ($):	$13,300 $4,000 $17,300		

Estimated Annual Total Savings ($):	$4,470	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	3.87	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	3.87	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	25	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	15.7%	Percent of Implementation Costs:	10.4%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: State Office Building

FWB Number:	12100	Eco Number:	6
Site:	State Office Building	Date/Time Created:	2/6/2012

Investigation Finding:	Building FCU Operate more than they should	Date Identified:	9/21/2011
Description of Finding:	The building fan coil units are operating in a manual mode causing the units to operate 24/7, regardless of the BAS signal.		
Equipment or System(s):	Other	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Equipment is enabled regardless of need, or such enabling is excessive		

Implementer:	In House Staff	Benefits:	Energy Savings
Baseline Documentation Method:	Spot checks of the approximately 450 FCU demonstrated they were operating during late evening times and when the automation system was set to have all units off. Further investigation demonstrated a override switch on a great majority of the units was set to manual operation, disabling the BAS interface. This allowed the FCU to operate 24/7 regardless of the BAS signal.		
Measure:	The finding will be fixed by switching the units back into auto mode.		
Recommendation for Implementation:	Through discussions with Scott Miron, a work order has already been placed to have the building engineer move the fan coil units back into automatic mode. This requires the building engineer to physically verify if the FCU is currently in manual or auto mode, and placing the switch into auto mode if required.		
Evidence of Implementation Method:	Spot verification of the fan coil units to demonstrate the units have been placed back into auto mode will demonstrate the finding has been corrected. Verifying the fan coil units are off when the BAS is sending a signal for the floor to be off will demonstrate they are being controlled at the BAS and not in manual operation.		

Annual Electric Savings (kWh):	30,691	Annual District Energy-Hot Water Savings (Gallons):	179,814
Estimated Annual kWh Savings ($):	$1,808	Est Annual District Energy-Hot Water Savings ($):	$3,791
Contractor Cost ($):	$3,000		
PBEEEP Provider Cost for Implementation Assistance ($):	$2,000		
Total Estimated Implementation Cost ($):	$5,000		

Estimated Annual Total Savings ($):	$5,599	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.89	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.89	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	39	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	19.7%	Percent of Implementation Costs:	3.0%

Findings Details

Building: State Office Building

FWB Number:	12100	Eco Number:	7
Site:	State Office Building	Date/Time Created:	2/6/2012

Investigation Finding:	Building Air Compressor operates more than it should.	Date Identified:	11/16/2011
Description of Finding:	Chris (Plant Maintenance Engineer) at the SOB described one of the air compressors as over heating (both the pump and motor) indicating a potential failure. Physically watching the compressors for 30 minutes showed the compressor operates for extensive runtime. The older compressor (appears to be original), operated for 1 minute 30 seconds on average during the 30 minute evaluation. Over this 1 minute 30 second time, it brought the air pressure in the system from 70 to 95 PSI. It then took 3 minutes 30 seconds for the pressure in the system to reduce from 95 to 70 PSI, enabling the other compressor. The compressor in question ran for 5 minutes 30 seconds to bring the pressure from 70 to 95 PSI, the time seems excessive when compared to the other compressor. Both compressors operate with 10 HP motors.		
Equipment or System(s):	Other	Finding Category:	OTHER
Finding Type:	Other		

Implementer:	Mechanical/Electrical Contractor and In House Staff	Benefits:	Energy Savings, Safety
Baseline Documentation Method:	The baseline was documented by spot verification of system performance. Physically verifying the time required for the air compressor to bring the system to its correct operating pressure demonstrates the excessive energy use for the compressor. The assumption in the energy savings calculation was that the air compressor will operate as such for a full year (8760 hours). The failing air compressor operated for 5 Min 30 Seconds. A new compressor could bring the system to the correct pressure in 1 Min 30 Seconds. This was verified while watching the second compressor. The compressors are currently operating in a lead-lag sequence, alternating each cycle.		
Measure:	The finding will be fixed by replacing the air compressor prior to failure.		
Recommendation for Implementation:	Disconnect the existing air compressor (piping and electrical) and remove the air compressor. Install new compressor (Model Ingersoll Rand 2545E10, 10 HP). New compressor to be in same location and utilize existing piping and electrical connections. Estimate includes cost for air compressor to be $4,199 from Grainger. Two days installation by electrical/mechanical to be approximately $1000/day ($125/hour) for an 8 hour day.		
Evidence of Implementation Method:	The measure could be verified through the use of an amperage data loggers or spot measurements. The new compressor should be able to bring the system back to the operating pressure in a similar time span to the second compressor.		

Annual Electric Savings (kWh):	10,539	Contractor Cost ($):	$6,199
Estimated Annual kWh Savings ($):	$621	PBEEEP Provider Cost for Implementation Assistance ($):	$500
		Total Estimated Implementation Cost ($):	$6,699

Estimated Annual Total Savings ($):	$621	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	10.79	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	10.79	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	9	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	2.2%	Percent of Implementation Costs:	4.0%

Findings Details

Building: State Office Building

FWB Number:	12100	Eco Number:	8
Site:	State Office Building	Date/Time Created:	2/6/2012

Investigation Finding:	Implement more efficient lighting options.	Date Identified:	11/16/2011
Description of Finding:	This measure looks at direct replacement of lighting fixtures to more efficient fixture options.		
Equipment or System(s):	Interior Lighting	Finding Category:	Retrofits
Finding Type:	Retrofit - Efficient Lighting		

Implementer:	Electrical Contractor and In House Staff	Benefits:	Energy Savings
Baseline Documentation Method:	The baseline was documented by physical verification of the existing lighting and utilizing the lighting spreadsheet provided by the state to determine fixture replacement to provide more energy efficient light sources. These lighting options are for direct replacement of fixtures and does not include altering lighting options as a means to improve the overall lighting of the facility.		
Measure:	The finding will be fixed by directly replacing the light fixture with a more efficient lighting alternative.		
Recommendation for Implementation:	The following lighting types are being addressed for oportunities to have direct replacement for energy savings. The lighting fixture types and potential changes include the following: 2x2 T8-32 Watt changed to 25 Watt, 1x4 and 2x4 T8-32 Watt changed to 25 Watt, CFL and Incandecent Downlight changed to LED Downlights, Wall Sconce 3-26 Watt quad changed to 1-32 Watt Triple, and replacement of existing exit lights to LED exit lights. The state reference fixture ID'S include the following fixtures: AL1, AL3, AP22, D85, E6, H, J1, K25, P25, W60. All internal lighting operates from 5:30 AM until 11:30 PM, this information was provided by Chris from the SOB. An additional $4,000 design fee is included to provide information related to verifying all lighting changes to be completed including specification of exact ballast and light bulb/fixture changes. The office cove lighting replacement was not included in the direct fixture replacement due to the longer payback period. Since the perimeter office lights are only on during session, the payback to do direct replacement to more efficient lighting options was greater than 20 years. In addition, a lighting re-design needs to be conducted in these offices to provide appropriate lighting levels.		
Evidence of Implementation Method:	Physical verification of lighting types will show a change to the more efficient energy saving light fixtures.		

Annual Electric Savings (kWh): Estimated Annual kWh Savings ($):	177,497 $10,456	Peak Demand Savings (kWh): Estimated Annual Demand Savings ($):	73 $4,573
Contractor Cost ($): PBEEEP Provider Cost for Implementation Assistance ($): Total Estimated Implementation Cost ($):	$105,023 $4,000 $109,023		

Estimated Annual Total Savings ($):	$15,030	Utility Co-Funding for kWh ($):	$3,752
Initial Simple Payback (years):	7.25	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	7.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	152	Utility Co-Funding - Estimated Total ($):	$3,752

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	52.9%	Percent of Implementation Costs:	65.7%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Architecture | Engineering | Planning

April 11, 2012

WRITER'S DIRECT DIAL 612-758-4227

Mr. Gordon Specht
Building Manager
Administration Department
50 Sherburne Avenue
St. Paul, Minnesota 55155

Re: State of Minnesota-State Office Building-St Paul-PBEEEP Energy Investigation
HGA Commission Number 0476-043-00

Dear Mr. Specht:

Please see below for additional findings of the PBEEEP Investigation.

Ramp Lighting Investigation
The original scope of the investigation study was to include an investigation of the ramp lighting energy and potential savings to utilizing a more efficient lighting option. Through discussions with building staff it was discovered the ramp lighting was already going through a lighting retrofit project. The ramp lighting investigation was removed as a direct result of this discovery.

Pneumatic Thermostat Calibration
Through discussions with building staff it was discovered a large portion of the pneumatic thermostats for the air handling unit VAVs and fan coil units are out of calibration. Chris at the facility discovered many of the thermostats did not have any air pressure at the thermostat which would not allow the VAV and thermostat to respond to changes in space temperature.

Recalibrating the VAV will greatly benefit the facility occupant comfort and allow individuals to have greater control of the temperature within the space. Currently, the building engineer is going through the process of recalibrating all thermostats within the space.

Office Lighting Retrofit
The final report includes an ECO finding which includes the replacement of a large portion of the facility lighting. It was discovered the lighting within the office space could be updated as well. Currently, the lighting is of a cove style which reflects lights off the ceiling and into the space. This light style provides poor lighting for the space, resulting in excessive use of task lighting in these office locations. This extra lighting uses an extensive amount of additional energy due to a poor lighting design.

Hammel, Green and Abrahamson, Inc.
HGA Architects and Engineers, LLC
HGA Architects and Engineers, LLP

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It was not recommended to replace the light fixtures within these offices due to the fact a full lighting design would be a more beneficial use of facility resources. A lighting redesign would provide a reduction in energy usage as well as a more acceptable lighting level for space occupants.

Perimeter Unit Heaters
The 6th Floor of the facility has unit heaters located around the perimeter of the space (approximately 16). Through the use of data loggers, it was discovered the space temperature is in excess of 65° Fahrenheit.

The space temperature could be reduced significantly for energy savings. An energy saving calculation was not conducted as this is a simple temperature adjustment with immediate payback and the calculation would have required an extensive evaluation of the envelope to determine heat transfer characteristics.

Conference Room Air Handling Unit Economizer Operation
The economizer operation for air handling units 4 through 12 could be optimized. Through trend data, it appears some units economize better than others and it could be beneficial to ensure the damper modulation performs more consistently. An energy saving calculation was not performed due to the small air handling unit size and the fact that these units are enabled to meet varying occupancy schedules which is at a reduced rate when compared to the overall facility occupancy schedule.

Even though the energy savings would be minimal, it would still be beneficial to optimize the economizer operation for both energy savings and occupancy comfort with an increase in fresh air implemented in the space.

Kitchen Exhaust Fan Operation
The kitchen exhaust fan is currently being operated even though the kitchen does not operate as a kitchen and no kitchen equipment is used. It was discussed with facility representatives that this fan is in use to remove space odor within the dining and adjacent areas. If the source of the odor issues is discovered and removed or altered, the exhaust fan could be removed from operation for energy savings.

Please contact me directly with any questions at 612-758-4227 or tmell@hga.com.

Sincerely,

Todd Mell, LEED AP
Mechanical Department

cc: Kate Zwicky, HGA

s:\0000\476\043-00\1. general communications\correspondence\20120411-tm-letter to specht.docx;vc

Xcel Energy®

414 Nicollet Mall, GO-6
Minneapolis, MN 55401

1-800-481-4700
xcelenergy.com

November 12, 2010

State of MN
Attn: Harvey Jaeger
50 Sherburne Ave. E.
St. Paul, MN 55155

Dear Harvey:

Thank you for participating in Xcel Energy's Recommissioning program. We have reviewed your study applications and proposals and have preapproved your studies. The following outlines your rebates and project information:

Building Address	**BCA - 1430 Maryland Ave. E., St. Paul, MN 55106**		
Study Cost	$38,200.00	Study Number	RM1526
Preapproved study rebate*	**$25,000.00**		
* Your rebate was based on the study cost provided. If the final study cost is lower, your rebate will be adjusted accordingly.			
Study Provider	**HGA**		
Account manager	**Barb Jerhoff**	Phone **651-229-5565**	

Building Address	**State Office Bldg - 41 Aurora, St. Paul, MN 55101**		
Study Cost	$43,200.00	Study Number	RM1525
Preapproved study rebate*	**$23,475.00**		

Here's a quick review of the Recommissioning program process:

- Once your studies are complete, your study provider will send a draft copy to us for review.
- After we complete our review and approve the studies, we will send you a confirmation letter noting our approval.
- Your study provider will schedule a wrap-up meeting with you and your Xcel Energy account manager to go over the results of the studies.
- You pay the study provider for the full cost of the studies.
- You submit the Recommissioning Study Rebate Application, along with a copy of the invoice and your Customer Implementation Plan, to us within 3 months of your report presentation. Please work with your account manager to complete the Customer Implementation Plan.
- We'll send your study rebate check to you.

414 Nicollet Mall, GO-6
Minneapolis, MN 55401

1-800-481-4700
xcelenergy.com

Please note that we need to approve the final study in order to receive your study rebate.

This study pre-approval is valid for **three months** from the date of this letter. If your studies will take longer than that, please let us know. If you have any questions or comments, please call your assigned Xcel Energy account manager. Thanks again for participating in our Recommissioning program.

Sincerely,

Jon Packer
Marketing Assistant, Recommissioning

Enclosure

CC: Barb Jerhoff - Xcel Energy
Sherryl Volkert - Xcel Energy
Kate Zwicky - HGA

Public Buildings Enhanced Energy Efficiency Program

ATTACHMENT 4:
SCREENING REPORT FOR STATE OFFICE BUILDING
PBEEEP #P12100

Date: 6/21/2010

This screening report is based on the PBEEEP Guidelines. It is based on one site visit, review of the facility documentation, building automation system, a limited inspection of the facility and interviews with the staff. The purpose of the screening report is to evaluate the potential of the facility for the implementation of cost-effective energy efficiency savings through recommissioning. To the best of our knowledge the information here is accurate. It provides a high level view of many, but by no means all, of the important parameters of the mechanical equipment in the facility. Because it is the result of a limited audit survey of the facility, it may not be completely accurate.

Summary Table

Facility Name	**State Office Building**
Location	100 Rev Dr Martin Luther King Jr Blvd, St. Paul, MN
Facility Manager	Gordon Specht
Number of Buildings	1
Interior Square Footage	272,085
Parking Ramp Square Footage	391 parking spaces (~ 120,000 sq ft)
PBEEEP Screening Provider	CEE (Gustav Brandstrom)
State's Project Manager	Harvey Jaeger
RECS Project Number	02658SOD
Date Visited	May 3, 2010
Annual Energy Cost	$351,191 (2009)
Utility Company	Xcel Energy (Electricity) District Energy St. Paul (Hot Water & Chilled Water)
Site Energy Use Index (EUI)	65.4 kBtu/sq.ft-yr (2009)
Benchmark EUI (from B3)	98.9 kBtu/sq.ft-yr

<u>Recommendation for Investigation</u>

A full investigation of the State Office Building with parking ramp is recommended.

Building Name	**State ID**	**Area (Square Feet)**	**Year Built**
State Office Building	G0231010462	272,085	1931
State Office Building Parking Ramp		Approx. 120,000	1981

State Office Building Screening Overview

The goal of screening is to select buildings where an in-depth energy investigation can be performed to identify energy savings opportunities that will generate savings with a relatively fast (1 to 5 years) and certain payback. The screening of the State Office Building was performed by the Center for Energy and Environment (CEE) with the assistance of the facility staff. This report is the result of that information.

The State Office Building is one large building consisting of 272,085 interior square feet. The building is controlled by a Honeywell EBI building automation system which is part of the State Capitol Complex system. All equipment is on the automation system except several unit heaters, which are controlled by manual thermostats on the wall. The building was constructed in 1931. It originally had a large central courtyard which was later incorporated into the building. No other major remodeling or renovation projects have been done. The HVAC systems are mostly original except for some motor replacements and the controls which are upgraded. The building has never had any projects commissioned or retrocommissioned. The occupancy varies throughout the year; it is highest during the state legislative session which runs from January through May. There is significantly lower occupancy in the summer.

The heating and cooling energy at the State Office Building is delivered by the District Energy to the state capitol loop which serves all the buildings on the capitol campus. The control of heating and cooling availability is based on outside air temperature and is controlled by the capitol loop, not the State Office Building. Heating is available when the outside air temperature is below 49°F and cooling is available above 64°F. There is no zone control for heating; if the heating pumps are running the building is heating. The heating system is split between AHUs and zone heat (FCUs and reheats) by different pumps and loops. The same is true for cooling, except there are no cooling loop pumps, just valves from the campus loop. Frequent manual adjustments by the building staff are required to maintain comfort for the occupants.

The two large VAV AHUs serve the first five floors, split into two halves (North and West; South and East). The ten smaller constant volume AHUs serve conference rooms, one AHU per room, all have cooling but only a few have heat. The sixth and seventh floors each have an AHU with both heating and cooling. The State Office Building has no true utility meters; however it has one electric meter, one hot water usage meter, and one chilled water usage meter. These are all submeters of the campus energy loops.

The State Office Building has an attached parking ramp. This ramp should also be investigated. There is very limited mechanical equipment, but a significant amount of lighting. Two of the three levels are above ground; the basement level is ventilated by two exhaust fans which run continuously. There is very limited mechanical equipment, but a significant amount of lighting. A lighting study of the building and the parking garage has been completed and will be used as the source of any proposed conservation measures.

State Office Building State ID# G0231010462					
Area (sq.ft)	272,085	Year Built	1931	Occupancy (hrs/yr)	4,268
HVAC Equipment					

Name	Type	Size	Notes
Fan S-1	VAV	40 hp SF, 37,400 cfm 10 hp RF, 37,400 cfm	Serving floors 1-5. North and West sides. Return fan is of type Axivane.
Fan S-2	VAV	30 hp SF, 37,180 cfm 10 hp RF, 30,500 cfm	Serving floors 1-5. South and East sides. Return fan is of type Axivane.
Fan S-3	Constant Volume	2 hp SF, 3,180cfm	Serves kitchen. Kitchen is not in use.
Fan S-4	Constant Volume	2 hp SF, 3,335cfm	Serves a large hearing room.
Fan S-5	Constant Volume	1.5 hp SF, 2,775cfm	Serves a large hearing room.
Fan S-6	Constant Volume	2 hp SF, 3,335cfm	Serves a large hearing room.
Fan S-7	Constant Volume	1 hp SF, 1,455cfm	Serves a large hearing room.
Fan S-8	Constant Volume	1 hp SF, 1,455cfm	Serves a small hearing room.
Fan S-9	Constant Volume	1 hp SF, 1,205cfm	Serves a small hearing room.
Fan S-10	Constant Volume	1 hp SF, 1,205cfm	Serves a small hearing room.
Fan S-11	Constant Volume	1 hp SF, 1,455cfm	Serves a small hearing room.
Fan S-12	Constant Volume	1 hp SF, 1,455cfm	Serves a small hearing room.
Fan S-13	Constant Volume	7.5 hp SF, 17,930cfm	Serves a small hearing room.
Fan S-14	Constant Volume	5 hp SF, 11,200cfm	Serves 6th Floor.
Fan S-15	Constant Volume	2 hp SF, 3,180cfm	Serves 7th Floor.
FCUs	4-Pipe FCU	200-600cfm (99% are 200-300 cfm)	One under each window on 1st through 5th floor. 468 FCUs total
HWPs-AHUs	Constant Volume	5 hp, 142 gpm	One pair of pumps for AHU heating
HWPs-Zones	Constant Volume	15 hp, 236 gpm	One pair of pumps for Zone heating (reheats and FCUs)

NOTE: Capacities are from design documentation and not verified.

Points on BAS

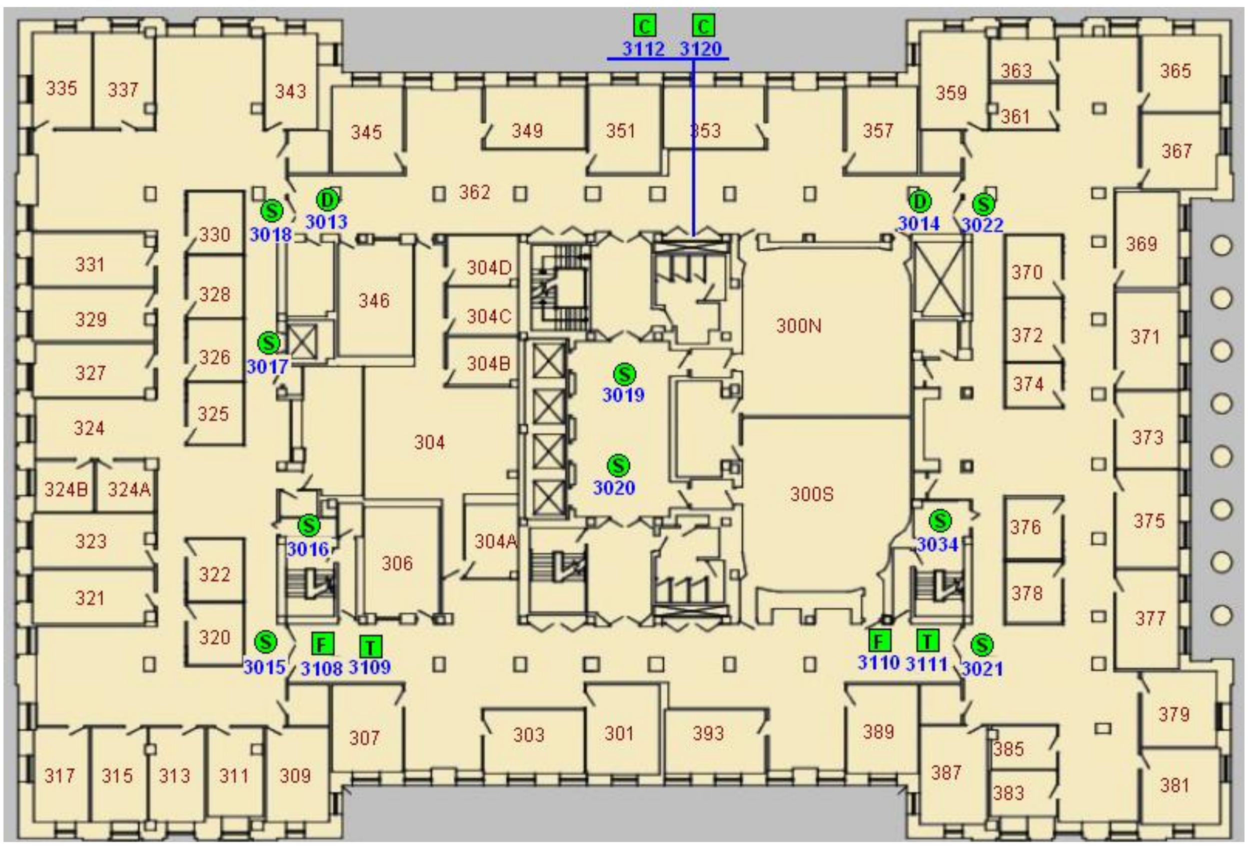
Name	Points	Notes
Fan S-1 Fan S-2	SF-S and Speed, RF-S and Speed, Heating Valve Pos, Cooling Valve Pos, Humidifier Valve Pos, DSP and Setpoint, Damper Pos and Min Pos, DAT and Setpoint, MAT, RAT, RARH and Setpoint, Room Temperature, OAT, Economizer Setpoint	
Fan S-3	SF-S, Heating Valve Pos, Cooling Valve Pos, Damper Pos and Min Pos, DAT and Setpoint, MAT, Room Temperature, Economizer Setpoint	
Fan S-4	SF-S, Heating Valve Pos, Cooling Valve Pos, Damper Pos and Min Pos, DAT and Setpoint, MAT, RAT, RARH, Room Temperature (3X), Economizer Setpoint	
Fan S-5 Fan S-6 Fan S-7	SF-S, RF-S, Heating Valve Pos, DX Cooling Status, Damper Pos and Min Pos, DAT, MAT, RAT and Setpoint, RARH, Room Temperature (3X), Economizer Setpoint	Fans S-6 and S-7 have Return Fans.
Fan S-8 Fan S-9 Fan S-10 Fan S-11 Fan S-12 Fan S-13	SF-S, Cooling Valve Pos, Damper Pos and Min Pos, DAT, MAT, RAT and Setpoint, RARH, Room Temperature, Economizer Setpoint	
Fan S-14 Fan S-15	SF-S and Speed, RF-S and Speed, Heating Valve Pos, Cooling Valve Pos, DSP and Setpoint, Damper Pos and Min Pos, DAT and Setpoint, MAT, RAT, Room Temperature, Economizer Setpoint	
CHW	CHWST, CHWRT-AHU and CHWRT-FCU,.	
HW	HWST and Setpoint, HWRT, P3 A and B Status, District Loop valve Position.	
Lighting	Each floor has ON/OFF, Each level in parking ramp has ON/OFF, Parking Lot ON/OFF.	

State Office Building Parking Ramp	State ID#				
Area	391 parking spaces	Year Built	1981	Occupancy (hrs/yr)	8,760
HVAC Equipment					

Name	Type	Size	Notes
North Exhaust Fan	Constant Volume		Serving enclosed parking in basement.
South Exhaust Fan	Constant Volume		Serving enclosed parking in basement.
CUH	Electric UHs		One on each floor in stairwell. (3X)

Points on BAS
No points on BAS. The exhaust fans previously ran on CO sensors, so there should be automation control somewhere. They now run continuously.

Plan of a typical floor



PBEEEP
State Government

PBEEEP Abbreviation Descriptions			
AHU	Air Handling Unit	HW	Hot Water
BAS	Building Automation System	HWDP	Hot Water Differential Pressure
CDW	Condenser Water	HWRT	Hot Water Return Temperature
CDWRT	Condenser Water Return Temperature	HWST	Hot Water Supply Temperature
CDWST	Condenser Water Supply Temperature	kW	Kilowatt
CFM	Cubic Feet per Minute	kWh	Kilowatt-hour
CHW	Chilled Water	MA	Mixed Air
CHWRT	Chilled Water Return Temperature	MA Enth	Mixed Air Enthalpy
CHWDP	Chilled Water Differential Pressure	MARH	Mixed Air Relative Humidity
CHWST	Chilled Water Supply Temperature	MAT	Mixed Air Temperature
CRAC	Computer Room Air Conditioner	MAU	Make-up Air Unit
CV	Constant Volume	OA	Outside Air
DA	Discharge Air	OA Enth	Outside Air Enthalpy
DA Enth	Discharge Air Enthalpy	OARH	Outside Air Relative Humidity
DARH	Discharge Air Relative Humidity	OAT	Outside Air Temperature
DAT	Discharge Air Temperature	Occ	Occupied
DDC	Direct Digital Control	PTAC	Packaged Terminal Air Conditioner
DP	Differential Pressure	RA	Return Air
DSP	Duct Static Pressure	RA Enth	Return Air Enthalpy
DX	Direct Expansion	RARH	Return Air Relative Humidity
EA	Exhaust Air	RAT	Return Air Temperature
EAT	Exhaust Air Temperature	RF	Return Fan
Econ	Economizer	RH	Relative Humidity
EF	Exhaust Fan	RTU	Rooftop Unit
Enth	Enthalpy	-S	Status
ERU	Energy Recovery Unit	SF	Supply Fan
FCU	Fan Coil Unit	Unocc	Unoccupied
FTR	Fin Tube Radiation	VAV	Variable Air Volume
HP	Horsepower	VFD	Variable Frequency Drive
HRU	Heat Recovery Unit	VIGV	Variable Inlet Guide Vanes

Conversions:
1 kWh = 3.412 kBtu
1 Therm = 100 kBtu
1 kBtu/hr = 1 MBH